D&E F16 Oven & Vib

MODEL DS-1501

THERMOTRON

PROPOSAL

IN THE BEGINNING
THERE IS PRICE

IN THE END,
THERE IS COST

As a businessman, you know there are certain things you would never buy on the basis of price alone.

And probably, way up near the top of that list are environmental facilities.

Thermotron doesn't sell test chambers on price. We sell on the value of experience, services, quality and performance.

These services and performance are designed to help you prevent and control losses of production and products; and losses are what determine ultimate cost.

That's why we don't just ask for the chance to QUOTE on your business. We want the chance to show you what we can be worth in the long run.

THERMOTRON
DYNAMIC SYSTEMS DIVISION
438 Cleveland Avenue
Holland, Michigan 49423 U.S.A.
Phone (616) 392-1492
TWX No. 810-292-6164

July 30, 1980

Honeywell, Inc.
1625 Zarthan Avenue
Minneapolis, Minnesota 55416

Attention: Mr. Sudan Mishra

Ref: Your Request For Quote

Gentlemen:

In response to your request, Thermotron Dynamic Systems Division is pleased to provide the attached proposal and specification #70680 for a DS-1501 Large Table Electrodynamic Vibration Testing System.

From the attached proposal you can see that the DS-1501 has many unique features. Some of these features are:

- A large 24" diameter specimen mounting surface, providing the capability of testing multiple test specimen, thus increasing product thru-put without necessitating a large and expensive head expander.
- A low profile (overall vertical height of 33") providing a roll-under interface with a new or existing AGREE Temperature Chamber, should the need arise for combined temperature/vibration tests. This interface is provided without major modifications to chamber and/or test facility.
- Long term reliability ensured through the use of conservatively rated system components and simplified system design.
- A completely air cooled power amplifier which eliminates the need for water, the associated elaborate piping, and heat exchangers required in water cooled power amplifiers.
- System requires only a single 3 phase power source.
- The capability of up-grading the DS-1501 system to a 6000 force pound RMS, 4500 force pound peak system in the field.

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- Short delivery time, typically 12 to 14 weeks, ARO.

- A nationwide product support program with trained service personnel and parts depots across the country; providing 24 hour turnaround on parts and service.

The DS-1501 will be capable of providing the 6 grms random vibration for payloads (specimen and fixturing) of up to 185 pounds. The reserve capability would provide the capability of testing two or three specimen (depending upon fixture weight) at one time, thus increasing product thru-put.

To provide the equalized random drive signal to meet your test requirements, two systems are proposed. The systems, a Manual Equalizer/Analyzer System and a Cassette Tape System, are detailed in the random control section of the proposal.

We look forward to assisting you in any way possible. If you have any questions or require any additional information, do not hesitate to contact us or our representative, Mr. Bill Swansen.

Very truly yours,

DYNAMIC SYSTEMS DIVISION

Douglas A Mahn

Douglas A. Mahn
Sales Associate

DAM/kw

Enclosures

cc: Torkelson Associates, Inc.
4940 Viking Drive
Minneapolis, MN 55435
(612) 835-2414

Quote File

PROPOSAL AND SPECIFICATION

DYNAMIC SYSTEMS DIVISION MODEL DS-1501

ELECTRODYNAMIC VIBRATION TESTING SYSTEM

- PREPARED EXPRESSLY FOR -

MR. SUDAN MISHRA

HONEYWELL, INC.

1625 ZARTHAN AVENUE

ST. LOUIS PARK, MINNESOTA 55426

PROPOSAL #: 70680

DATE: July 30, 1980

BY: Douglas A. Mahn
Dynamic Systems Division

THERMOTRON INDUSTRIES
Holland, Michigan

MODEL DS-1501 ELECTRODYNAMIC VIBRATION TESTING SYSTEM

THERMOTRON

SPECIFICATIONS

VIBRATION SYSTEM DESCRIPTION

The DS-Series Vibration Testing Systems incorporate many unique features which are designed to satisfy a wide range of vibration testing applications. The basic system, detailed in the following description, utilizes a large table electrodynamic shaker interconnected with a two bay vibration console which provides the control and monitoring for complete system operation. The following summary details the individual system components and integration for the specified system performance.

ELECTRODYNAMIC SHAKER

The DS-Series Shaker is a double-ended gap, low profile, air-cooled electrodynamic shaker designed for maximum efficiency and reliability.

The double-ended, magnetic gap structure of the shaker provides a uniform force output over the full peak to peak stroke range of the armature. Utilizing this type of structure also reduces the stray magnetic field at the armature specimen mounting surface.

The 33 inch, low profile design of the shaker provides the capability of interfacing the shaker to a new or existing AGREE Temperature Chamber utilizing a simple diaphragm seal. This avoids costly modifications and system down time.

The large body mass of the DS-Series Shaker (6000 pounds) is a substantial reaction mass thus eliminating the need for a large seismic mass for most testing applications.

Armature

The heart of the DS-Series Shaker is the unique design of the armature. The armature incorporates a rugged alloy casting of radial-finned design which uniformally directs the forces, generated in the two layer drive coil, through a single structure to the specimen mounting surface. The unique armature structure provides the shaker with a large specimen mounting surface, 24 inches in diameter. With this large mounting surface, the shaker has the capability of accepting large or multiple payloads without elaborate or costly fixturing which can introduce unwanted system resonances. To facilitate specimen mounting, the mounting surface incorporates 25 stainless steel standoffs (3/8-16 UNC) arranged on concentric bolt circles of 24", 16", and 8" diameters with one standoff in the exact center. The standoffs are designed for minimum thermal transfer and extended life for long term reliability testing.

Armature Guidance and Suspension

The DS-Series Shaker incorporates an armature guidance and suspension system of eight dampened lateral flexures and dual linear guide bearings to enhance control of dynamically unbalanced payloads and provide positive control of overturning moments for rectilinear motion. The eight beryllium copper laminated leaf flexures, designed for long life and high reliability, provide the shaker with a 5000 pound per inch vertical suspension stiffness. This suspension system provides the shaker with the capability of accepting larger payloads not possible with a four flexure system.

Field Coils

The DS-Series Shaker utilizes four anodized aluminum ribbon field coils to provide the shaker static magnetic field. The field coils are equipped with a personnel protection diode that, should the field coils ever open, prevents the rapidly collapsing magnetic field from transmitting high voltage transients to either equipment or operator. The aluminum field coils are light in weight and have a high heat to air transfer characteristic.

Shaker Cooling

To provide maximum heat transfer during shaker operation, the DS-Series Shaker utilizes air cooling via a remotely located, 950 CFM, cooling blower.

Shaker cooling is accomplished by drawing cool ambient air into the shaker just below the shaker thermal shield. The heated air is exhausted through a plenum at the bottom of the shaker to a remote cooling blower by twelve foot of flexible ducting.

Thermal Isolation

Incorporated into the DS-Series Shaker, as standard equipment, is a thermal isolation system. This system isolates the shaker from the AGREE Temperature Chamber environment over the range of -57°C. to 93°C. Isolation is accomplished by utilizing a thermal shield, isolating material, stainless steel standoffs, and the optional shaker/chamber diaphragm seal.

Thermal Isolation (Continued)

The thermal shield is a stainless steel shroud that covers and protects the top of the shaker, and when used in conjunction with the diaphragm seal isolates the shaker from the thermal environment of an AGREE Chamber. Since the thermal shield extends twelve inches below the Diaphragm Seal, the shield ducts in cooler air and inhibits the shaker from recirculating conditioned air from the chamber.

The shaker table surface is isolated from the chamber by utilizing multiple thickness of 1/2" closed-cell silicone sponge rubber and the stainless steel standoffs. When combined with the ABM 8101 Diaphragm Seal, the system, not only, thermally isolates the shaker, but also, provides a moistureproof barrier between the chamber and shaker.

Shaker Mobility

To facilitate movement of the shaker under an AGREE Chamber, the DS-Series Shaker is equipped with four "V" grooved steel wheels. The wheels, which are attached to the shaker body, are designed to interface directly with the optional Model ABM-8163 Track Assembly (see ABM-8163 Track Assembly Description).

Shaker Interconnection

All interconnections between the shaker and vibration console are readily accessible to facilitate ease in system maintenance and troubleshooting. The shaker interconnections are accomplished in the shaker junction box

Shaker Interconnection

and connected to the vibration console via twenty (20) feet of flexible conduit. In this junction box is accomplished connections for the field coils, armature coil, integrated accelerometer and shaker safety interlocks.

Also housed in this assembly is the shaker cooling interlock. The interlock, which monitors the air pressure in the blower plenum, returns the vibration system to the standby mode should shaker cooling be interrupted. The interlock prevents the shaker from being damaged by over heating.

VIBRATION CONSOLE

The DS-Series Vibration System incorporates a vibration console to integrate system control and monitoring functions. The vibration console utilizes a standard 19", two bay rack to house the solid state power amplifier, D.C. Field Power Supply, level monitor, central control panel and a power distribution system.

Power Distribution System

The power distribution panel in the vibration console provides a centralized location for distribution of power to all equipment housed in the console as well as the remotely located cooling blower. This central distribution of power is possible because the vibration console utilizes a transformer to provide the low voltage (115 VAC) where required from a single three phase power source.

Power Distribution System (Continued)

The power distribution system is housed in a separate locked compartment in the vibration console and incorporates a power disconnect switch in the handle of the compartment. This disconnect, as well as the interlocks of the rear doors of the console, removes all electrical power from the system when opened. This prevents accidental exposure of the operator or other personnel to high voltage. Also located on the power distribution panel is a terminal strip which provides access to the sequential interlocks and low voltage supplies for rapid troubleshooting.

Central Control Panel

To provide simplified system operation with very few controls, the vibration system has incorporated into the vibration console a central control panel. The central control panel facilitates system start-up and shutdown as well as providing a visual check of the shaker operation. Also incorporated into the central control panel is a sequential interlock system that prevents shaker operation unless all interlocks are satisfied. Part of this interlock system inhibits a signal from being applied to the shaker unless the master gain control is fully counterclockwise. This in-interlock prevents full level turn-on which could possibly damage the test specimen.

The vibration system start-up and shutdown can be either locally or remotely controlled at the central control panel. Local control provides manual start-up and shutdown from the front of the Central Control Panel.

Central Control Panel (Continued)

Remote control provides automatic start-up and shutdown from a remote programmer such as a cam programmer, automatic timer, paper tape command or microprocessor.

Field Supply

The vibration console also houses the DC Field Power Supply which provides power to the shaker field coils which produces the necessary static magnetic field for full force shaker operation. This supply is a simple air-cooled, three phase, full wave bridge type and is equipped with over-current protection.

Acceleration Monitor

For continuous indication of overall acceleration, a Model 774000 Level Monitor is incorporated into the vibration console. The level monitor is capable of monitoring either RMS or peak levels of acceleration by means of a peak/RMS selector switch. The level monitor also incorporates an operator presetable high safety cutoff which when exceeded immediately returns the Power Amplifier to the standby mode.

The level monitor also provides two conditioned outputs for use with optional control, monitoring and analysis equipment. One output is a normalized AC signal of 100mv per g that can be used as an input signal to a Real Time Analyzer or feedback signal to a sinewave servo. The other output is a DC voltage which is proportional to linear amplitude and can be used directly for the Y-axis drive of an X-Y Recorder.

Power Amplifier

An air-cooled, solid state power amplifier of unique design is incorporated into the vibration console to provide the drive current for the armature coil. This power amplifier is matched to drive the shaker to full output capability over the specified frequency range.

The main circuitry of the power amplifier is direct coupled and incorporates a patented bridge circuit with the latest in solid state design to provide extremely low total harmonic distortion as well as an excellent signal to noise ratio. The power amplifier has increased reliability, insured through the use of conservatively rated silicone transistors in the output stage.

To facilitate proper system operation, the power amplifier utilizes a panel meter and various indicator lights. The panel meter provides an accurate indication of the amplifier peak output voltage while the indicator lights provide a visual indication of the amplifier operating parameters.

Power amplifier cooling is accomplished by utilizing a self-contained low velocity air cooling system. This method of cooling is less complicated and requires less maintenance than water cooled power amplifier.

An independent interlock system, incorporated into the power amplifier, utilizes semi-conductor logic to monitor output load condition, line voltage and amplifier temperature for an out-of-tolerance condition. This interlock system is integrated with the other vibration system interlocks

Power Amplifier: (Continued)

and immediately returns the total system to a stand-by mode should an out-of-tolerance condition be experienced in the power amplifier.

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SPECIFICATIONS

ABM 8104 PNEUMATIC VIBRATION ISOLATION SYSTEM

The Pneumatic Vibration Isolation System is designed to eliminate unwanted vibration transmission into the surrounding laboratory floor due to the shaker operation.

To accomplish this isolation, the Model ABM 8104 utilizes four air mounts (attached to the shaker body structure) which lift the shaker with a three point leveling system to use the 6000 pounds of the body as an isolated reaction mass. The Isolation System, when fully inflated, (using a standard shop air supply 90 psi max.) exhibits a 3.5 Hertz natural frequency which yields less than 15% transmissability above 10 Hertz.

Since the Model ABM 8104 is mounted outboard of the shaker body assembly, the shaker maintains a low center of gravity and a high degree of lateral stability even with large unbalanced payloads. The Isolation System does not interfere with the standard V-grooved wheels and track assembly, such that; the shaker may be wheeled under an AGREE chamber and with the positioning of a single lever gate valve (located on the shaker) activate the isolation system which lifts the shaker wheels from the track. The reverse process will permit withdrawal of the shaker from the chamber.

The ABM 8104 Isolation System is also designed to allow use of the DS-Series Shakers for stand-alone screening applications.

RANDOM CONTROL

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SPECIFICATIONS

RANDOM VIBRATION CONTROL AND MONITORING

To provide control and analysis of random vibration test, one of the following systems can be incorporated into the DS-1501 Vibration System. The systems are a manual equalizer/analyzer system; or a cassette tape system. Either of these systems will be capable of providing an equalized random drive signal.

Manual Equalizer/Analyzer

The manual equalizer/analyzer system consists of the Model SE-28 Spectrum Equalizer, the Model 500AS-1 Digital Swept Analyzer, and the Model HP7015B X-Y Recorder. The SE-28 Spectrum Equalizer, with built in random noise generator, incorporates 28 independent active Butterworth filters to provide an economical method of shaping random spectra (refer to attached specification sheet). The 500AS-1 Digital Swept Analyzer (refer to attached sheet) incorporates 10, 25, 50, and 100 Hz bandwidth filters to provide a swept analysis of random data. Data analyzed by the 500AS-1 is displayed in P.S.D. form utilizing the HP7015B X-Y Recorder.

Cassette Tape System

The cassette tape system is another method of providing random vibration testing capabilities. The cassette tape system available is the Model TRP-I Taped Random Programming System (refer to attached specification sheet). The TRP-I is designed to provide low cost, preprogrammed random vibration for production screening applications.

Cassette Tape System (Continued)

By implementing the procedure detailed in the enclosed paper entitled "Practical Application of Tape Random Screening Using Digital Vibration Control Systems", a cassette tape can be generated for each test configuration. Then as different test specimen are installed, the appropriate cassette tape is selected and used to provide the random drive signal. The TRP-I System would thus reduce test set-up time as well as reducing test sophistication to routine.

OPTIONAL EQUIPMENT

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SPECIFICATIONS

ABM 8108 - REMOTE COOLING BLOWER QUIET PACKAGE

The Remote Cooling Blower Quiet Package is a lightweight modular sound absorbing enclosure designed to reduce the noise level of the remote cooling blower to a level of 75 dBA or less, as measured three feet from the blower.

The acoustic enclosure 31 1/2" x 24 3/4" x 24" is constructed of specially designed sound absorbing materials encased in galvanized sheet metal with a backing consisting of wire mesh and film sheeting to prevent contamination of the air by loose fiber. The cooling air from the enclosed remote cooling blower is exhausted through two specially designed sound absorbing labyrinth mufflers.

DS-1501 SYSTEM PERFORMANCE

SPECIFICATION

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SPECIFICATIONS

SYSTEM PERFORMANCE SPECIFICATION

The DS-1501 exhibits the following system performance characteristics:

Frequency Range: 5 - 2000 Hz. -- Sinewave
20 - 2000 Hz. -- Random

Force Rating: Sinewave: 1700 pounds force peak
Random: 1900 pounds force RMS for a uniform power spectral density over the specified frequency range with loads of 130 pounds or greater.

System Operation: Continuous duty at full rated output with a maximum displacement of 0.5 inches peak to peak and a maximum velocity of 20 inches per second.

Optional flexures for one inch peak to peak displacement available.

Payload Capabilities: Payload is defined as the specimen, fixture and all other hardware mounted to the table surface (excludes armature weight).

Sinewave		Random	
Acceleration Level	Payload	Acceleration Level	Payload
2 g peak	720 pounds	2 GRMS	820 pounds
4 g peak	295 pounds	4 GRMS	345 pounds
6 g peak	153 pounds	6 GRMS	186 pounds

NOTE: Maximum payload support is 5000 lbs. per inch.

System Hum and Noise: Less than 0.1 GRMS

System Utility Requirements: Power - 460 volt, ± 10%, 3 phase, 60 Hz.

Air Exhausted - Approximately 1000 CFM

NOTE: Customer is responsible for connections to all utilities and a main power disconnect unless otherwise stated.

DS-1501 UTILITIES DATA

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SPECIFICATIONS

INSTALLATION AND UTILITIES DATA

DS-1501

Power:	460, 3 phase, 60 Hz. 13 KVA
Air Cooling:	Air Flow - Shaker Blower - 950 CFM Control Console - 900 CFM
	Heat Dissipated - Shaker Blower - 45,000 BTU/Hr Control Console - 3,800 BTU/Hr
Shaker (Less Pneumatic Isolation):	Weight - 5800 lbs. Dimensions Ht. - 33" W. - 29 3/16" L. - 41 1/4"
Shaker (With Pneumatic Isolation):	Weight - 6000 lbs. Dimensions Ht. - 33" W. - 36 1/2" L. - 51 1/2"
Control Console (Less optional equipment:	Weight - 700 lbs. Dimensions Ht. - 72" W. - 42 1/4" D. - 26"
Remote Cooling Blower:	Weight - 100 lbs. Dimensions Ht. - 19" W. - 21" D. - 18"
Remote Cooling Blower Quiet Package:	Weight - 125 lbs. Dimensions Ht. - 24" W. - 31 1/2" D. - 34 3/4"
Air Exhaust Duct (Shaker to Remote Cooling Blower):	6" Dia. x 12'
Shaker Interconnect:	Control Console to Shaker - 1" Dia. x 20' Flexible Conduit Control Console to Remote Cooling Blower - 1/2" Dia. x 20' Flexible Conduit.

EQUIPMENT LIST

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SPECIFICATIONS

EQUIPMENT LIST

A. Basic DS-1501 System

ITEM	QUANTITY	DESCRIPTION
1	1	Model DS-1501 Electrodynamic Vibration Testing System, consisting of:
1a	1	Model DS-1501 Large Table Electrodynamic Shaker with V-grooved wheels and integral monitor accelerometer.
1a-1	1	Model ABM 8104 Pneumatic Vibration Isolation System.
1b	1	Remote Cooling Blower Assembly with 6 inch diameter flexible duct - 12 ft. long.
1c	1 set	Standard interconnecting cable assembly; console to shaker - 20 ft. long; console to blower - 20 ft. long.
1d	1	Two Bay Control Console containing:
1d-1	1	Model FS 1501 Field Power Supply.
1d-2	1	Model DS-4023Z Overall Vibration Level Monitor with high safety cutoff.
1d-3	1	Model M-600A Solid State Power Amplifier.
1d-4	1	Model CP 1501 Central Control Panel for system start-up and shutdown.
2	1 set	Standard instruction manuals and installation drawings.
3	1 lot	Start-up and checkout of system at your facility.

System Price - $39,275.00

Delivery - 10 to 12 weeks, ARO

B. Random Testing Capabilities

Either of the following systems can be incorporated into the basic system to provide random testing capabilities.

ITEM	QUANTITY	DESCRIPTION
4	1	Manual Equalizer/Analyzer System consisting of:
4a	1	Model SE-28 Spectrum Equalizer with built in random noise generator.
4b	1	Model 500AS-1 Digital Swept Analyzer with 10, 25, 50, and 100 Hz. bandwidth filters.
4c	1	Model HP-7015B X-Y Recorder.

Manual Equalizer/Analyzer Price - $12,065.00

5	1	Cassette Tape System consisting of:
5a	1	TRP-I Taped Random Programming System.

Cassette System Price - $3,500.00

C. General Options

ITEM	QUANTITY	DESCRIPTION	PRICE
6	1	ABM-8108 Quiet Package for shaker remote cooling blower.	$ 710.00
7	1	Model DS-4021Z Accelerometer with 10 foot cable.	$ 402.00

All prices quoted are F.O.B. Holland, Michigan in accordance with the attached Terms and Conditions.

TERMS AND CONDITIONS

The following is a list of terms and conditions which are applied to the equipment and services proposed.

(1) Unless stated otherwise, the prices are quoted F.O.B. Holland, Michigan exclusive of all local and state licenses, taxes and inspections which are to be paid by the purchaser.

(2) Dynamic Systems Division warrants that the prices quoted are complete and accurate at the time of proposal and will remain valid for the period of the quotation. D.S.D. also warrants that the prices quoted are established and published and are not greater than prices quoted to other customers or agencies at the United States Government, for similar equipment and services in like quantities.

(3) Validation Period - this proposal is valid for a period of 45 days.

(4) Warranty - a statement of Limited Warranty is enclosed and incorporated by reference.

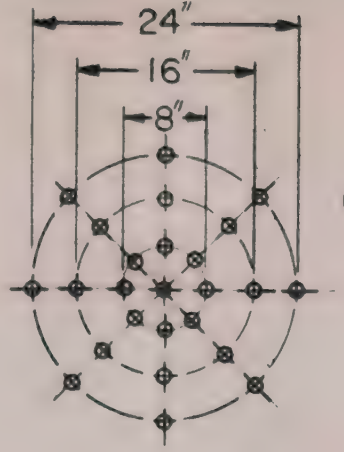
(5) Payment Terms:

(a) Net 30 days

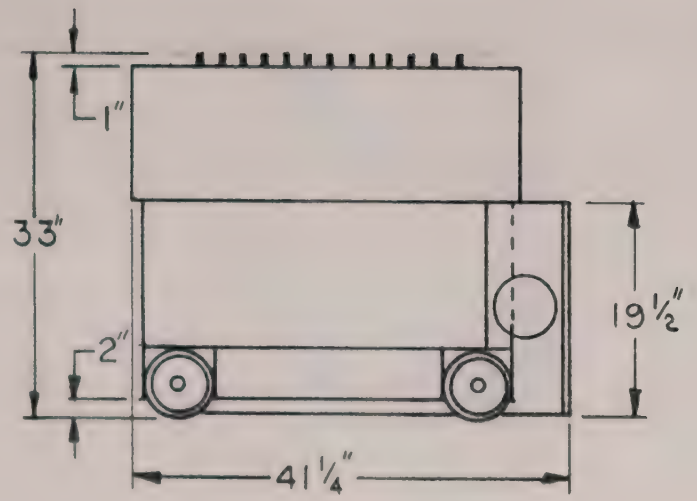
(b) Invoice Schedule, payable:

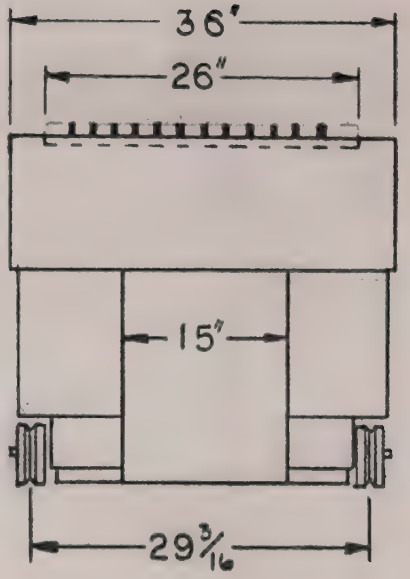
20% Upon order placement
35% Within six weeks
35% Upon shipment
10% Upon acceptance (if start-up included)

DRAWINGS



(25) 3/8-16 B UNC
S.S. STANDOFFS





SYM	DATE	CHANGE	BY	SYM	DATE	CHANGE	BY
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MATERIAL

THERMOTRON CORP.
HOLLAND, MICHIGAN U.S.A.

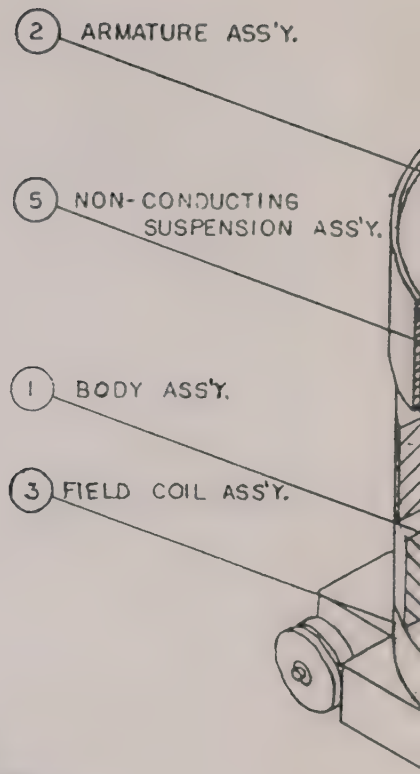
DRAWN BY	DATE	SCALE	APPROV.
MWA	11-22-77		

DESCRIPTION
SHAKER DIMENSIONAL DW6.

FOR 1500, 2500, 4000

DRAWING NO. DS-7009

SIZE Z



NOTE:
AIR EXHAUST DUCT CAN BE LOCATED ON EITHER SIDE OF BLOWER BOX.

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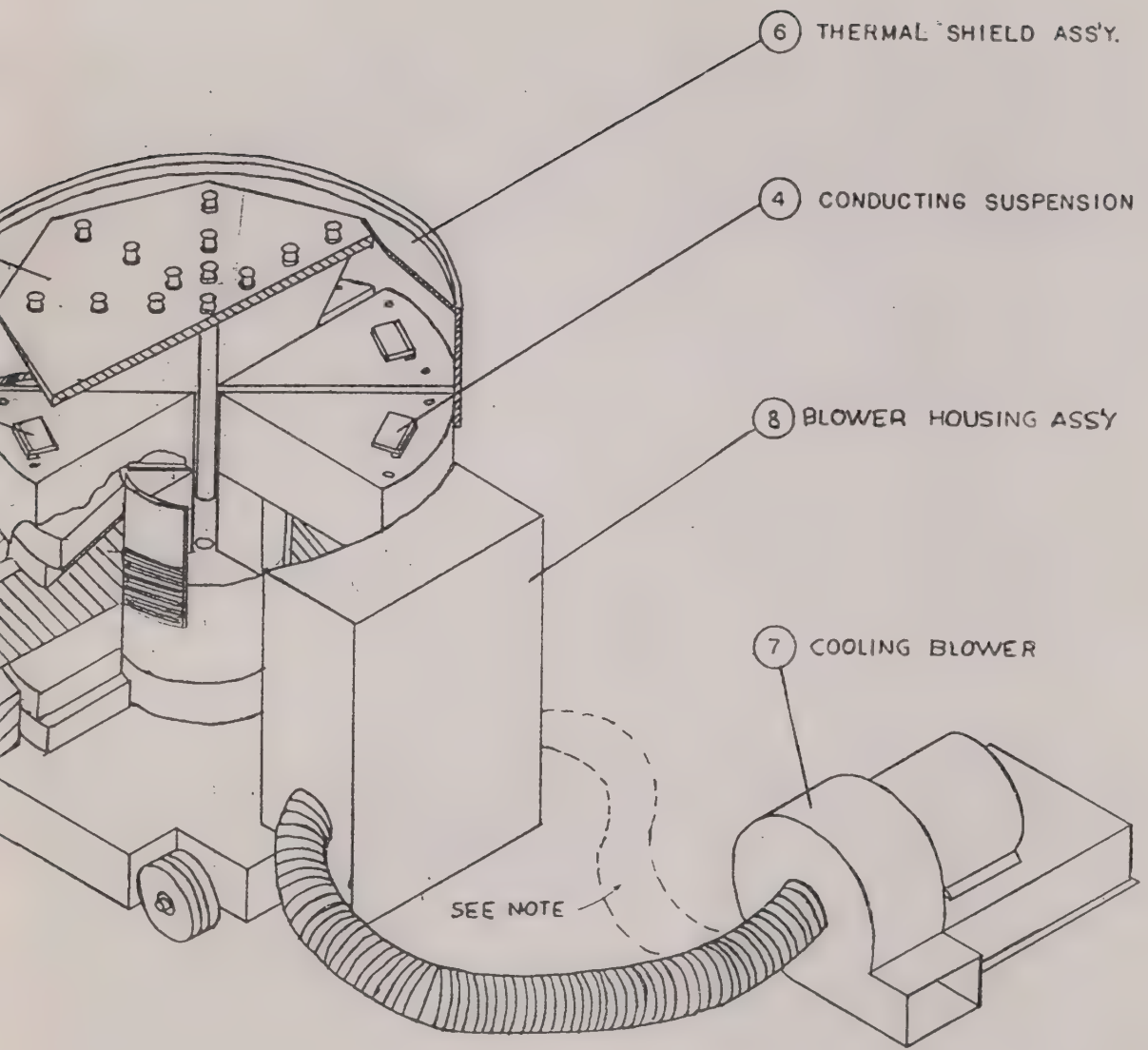

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MATERIAL

THERMOTRON CORP.
HOLLAND, MICHIGAN U.S.A.

DESCRIPTION: SHAKER ASSEMBLY

FOR

DRAWING NO. DS-1356

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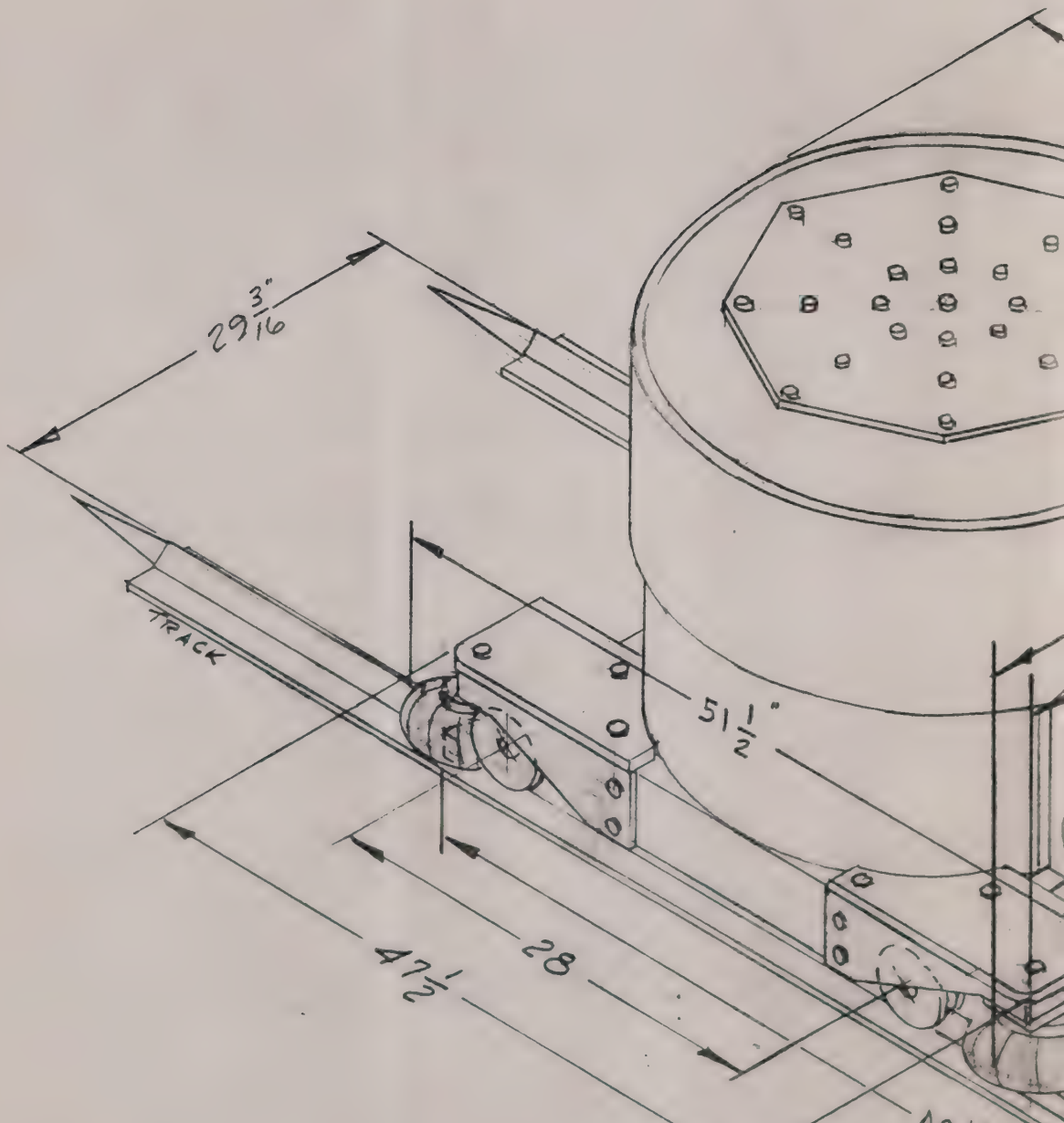

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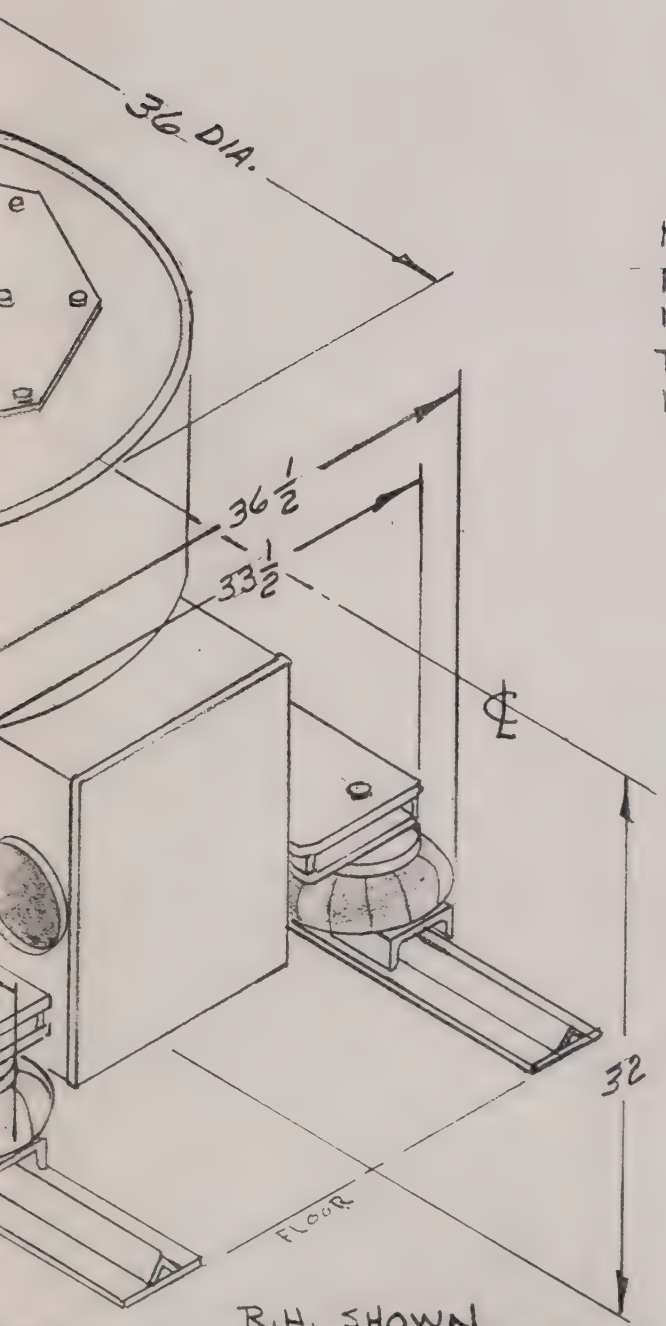

R.H. SHOWN

NOTE:
PNEUMATIC ISOLATION SYSTEM
NATURAL FREQUENCY 3.5 HZ.
TRANSMISSIBILITY ABOVE 10 HZ.
LESS THAN 10%

STATIC WEIGHT 6000 LBS

SYM	DATE	CHANGE	BY
C			
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MATERIAL

THERMOTRON CORP.
HOLLAND, MICHIGAN U.S.A.

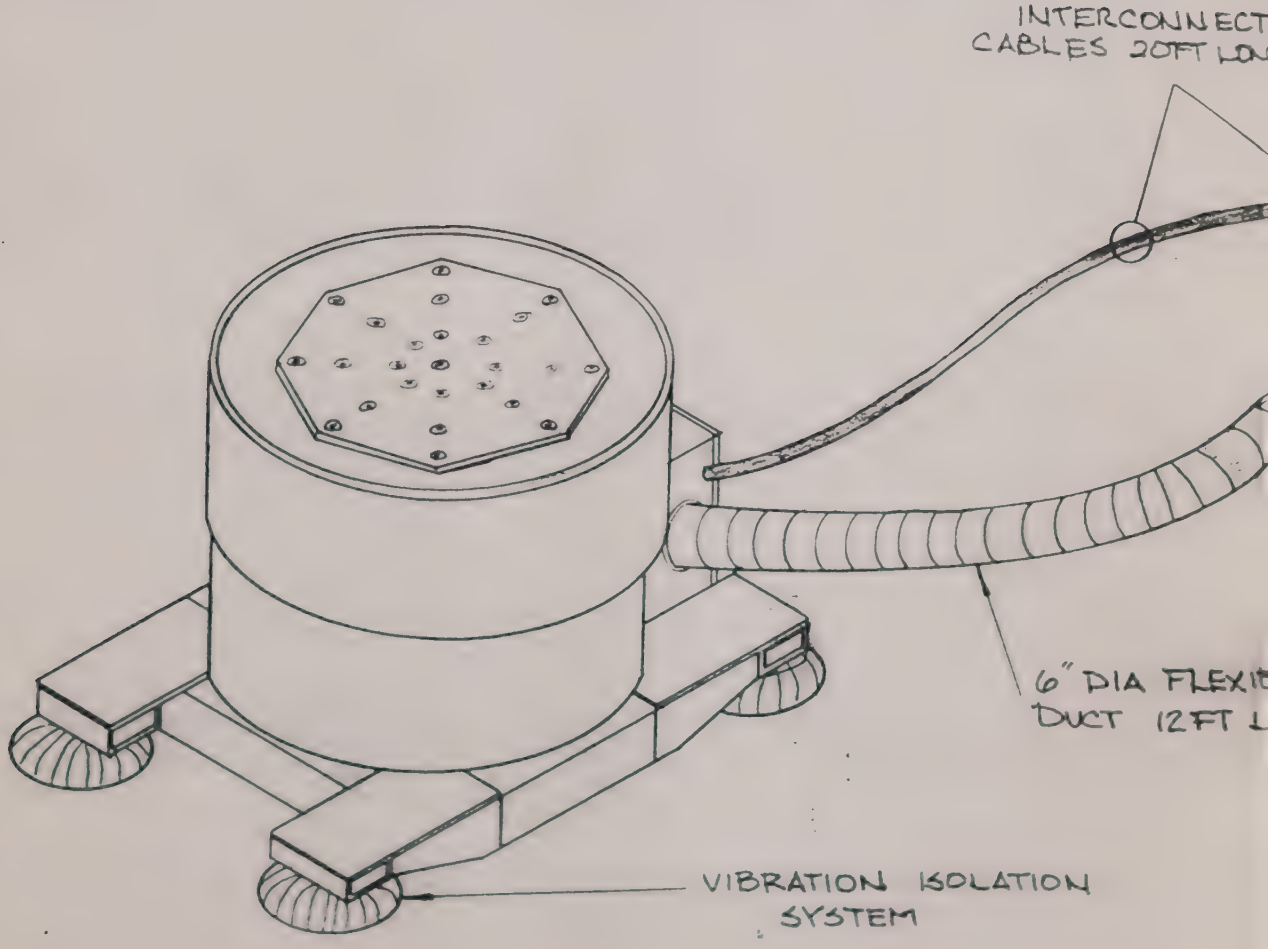
DESCRIPTION: SHAKER WITH ISOLATION SYSTEM

FOR

DRAWING NO. DS-6007

SIZE Y

OPT



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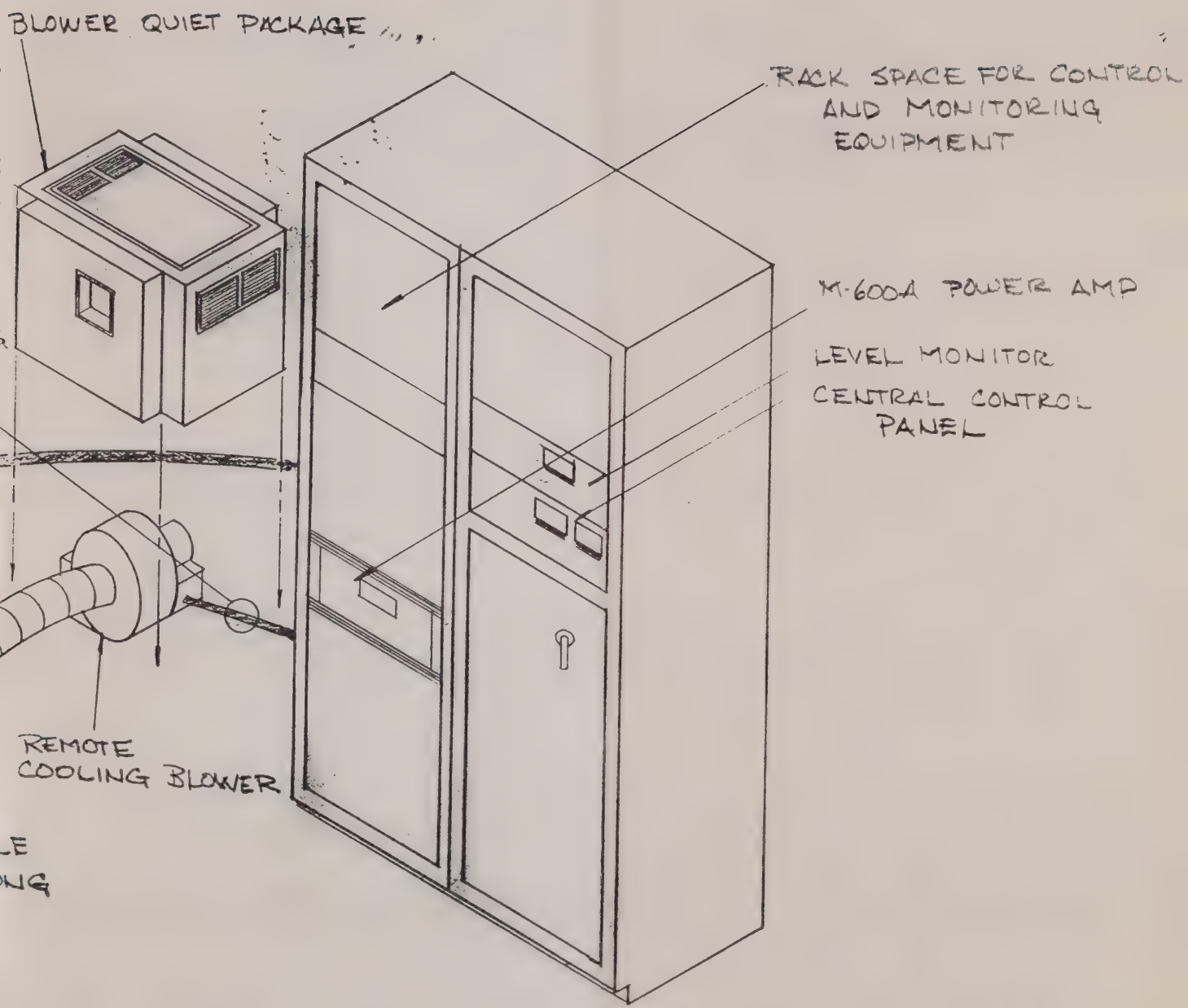


SYM	DATE	CHANGE	BY	MATERIAL	THERMOTRON CORP. HOLLAND, MICHIGAN U.S.A.
C					
D					

DESCRIPTION: TM-CAM DS-1501 STAND ALONE | FOR: | DRAWING NO.: DS-7027 | Y

LITERATURE AND SPECIFICATION

SHEETS

Anybody can build a shaker, but at what cost?

Before selecting a shaker system, you should consider all the costs — initial cost, life cycle costs and through-put rate.

So why not rely on Thermotron Dynamic Systems to help you reach a cost effective decision. After all, our extensive experience has made us the world's largest designer and manufacturer of combined temperature/vibration systems. We have more systems in the field and in operation than anybody else.

Dynamic Systems also offers you a shaker that is flexible in design. It can be easily and economically configured with standard accessories to satisfy MIL-STD 781C, MIL-STD 810C, NAVMAT P9492, and other stress screening or reliability applications. Each DS Series System is backed by the most comprehensive support program available including start-up, trained service personnel and parts depots across the country.

Building a shaker is one thing, doing it better is ours.
Thermotron Industries, Dynamic Systems Division,
438 Cleveland Avenue, Holland, Michigan 49423 U.S.A.
Phone (616) 392-1492.

THERMOTRON

Thermotron Team Work Puts It All Together

Vibration + Temperature + Humidity + Complete Programming

Thermotron Integrated Systems are in use in these programs and industries

- ☐ Cruise Missile & ALCM Development
- ☐ Harpoon Missile
- ☐ F18 Fighter
- ☐ XM-1 Battle Tank
- ☐ MK47 Torpedo
- ☐ Auto Air Conditioning
- ☐ Auto Electronic Components
- ☐ Auto Production Screening
- ☐ Industrial Processing
- ☐ Industrial Reliability Test

Thermotron is an application-oriented company with an engineering team and nation-wide service organization to design your system, integrate your facility and service your equipment.

THE LARGEST MANUFACTURER OF TOTAL ENVIRONMENTAL TEST SYSTEMS

THERMOTRON INDUSTRIES
DYNAMIC SYSTEMS DIVISION

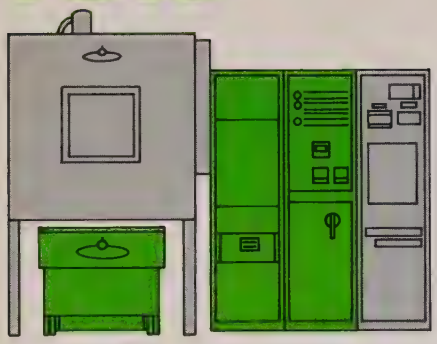
KOLLEN PARK DRIVE | HOLLAND, MI 49423
Phone (616) 392-1492 | TWX 810-292-6164

TOTAL SYSTEMS FOR MILITARY STANDARD 781C TESTING

Electrodynamic Vibration System, A.G.R.E.E. Chamber, Microcomputer Programmer—Controller

THERMOTRON

781C



THERMOTRON D. S. SERIES

Electrodynamic Vibration Testing Systems

MIL-STD-781C REQUIRES

- Random vibration 20-2000 Hz, sine wave 5-2000 Hz.
- Large systems and subsystems tested simultaneously.
- Long-term mission profile test.
- Combined temperature and vibration profiles.
- Control tolerances similar to MIL-STD-810C.

Dynamic Systems Division vibration test systems meet and exceed the requirements of MIL-STD-781C . . .

HERE'S HOW

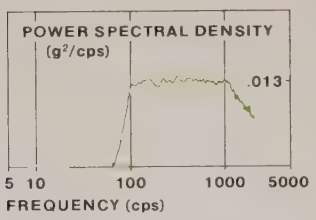
- Large table mounting surface (24")—accommodates large or multiple payloads without *massive* and costly head expanders.
- Electrodynamic design—provides true gaussian distribution random excitation.
- Reliability—assured through use of conservatively rated, air-cooled components combined with the latest solid state technology.
- Control Tolerance—typically +3dB, −1.5dB attainable.
- Combined Temperature/Vibration operation—has integral thermal shield to operate from −57° to +93° C.

FEATURES

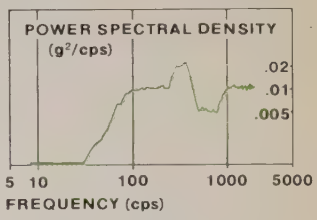
- Low profile 33" adapts readily to existing chambers, avoids costly modification. For retrofit capability.
- Large table surface—24"
- Lower purchase and operating cost.
- Delivery: typically 8-12 weeks or better.
- Sine or random testing.
- Field expandable
- Systems designed to integrate with all Thermotron standard AGREE chambers.

MISSION PROFILES

ACCELERATION RESPONSE SPECTRUM



ACCELERATION RESPONSE FOR A SHAPED TEST SPECTRUM



Through the use of manual or automatic equalizer systems practically any mission profile can be duplicated within the system operating parameters

Typical random spectrum profiles which can be simulated with the DS series show the flexibility of the total system.

FIVE STANDARD SYSTEMS AVAILABLE

DS-1500—1500 pounds Force RMS, 1200 lbf peak
DS-1501—1900 pounds Force RMS, 1700 lbf peak
DS-2500—2500 pounds Force RMS, 2000 lbf peak
DS-4000—4000 pounds Force RMS, 4000 lbf peak
DS-4001—6000 pounds Force RMS, 4500 lbf peak

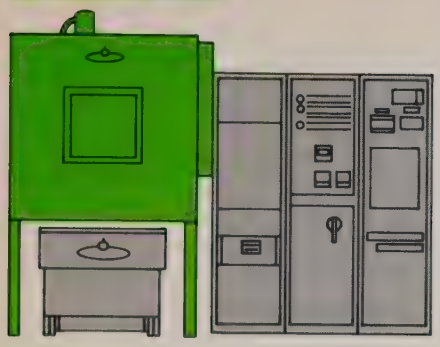
ALL SYSTEMS INCLUDE

- Large table electrodynamic shaker.
- Solid state power amplifier.
- Overall vibration level monitor with safety interlock.
- Central control panel for Local or Remote operation.
- Thermal shield.

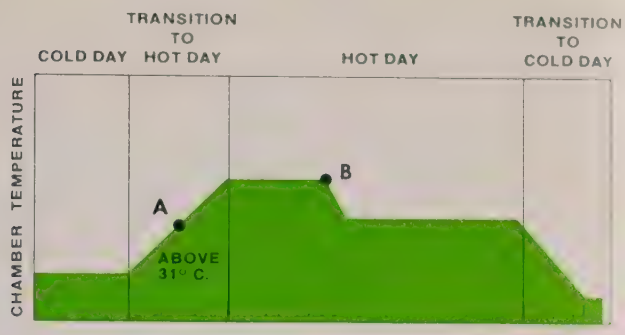
ACCESSORIES AVAILABLE

- Thermotron Model SE-28 Spectrum Equalizer.
- Vibration Isolation System.
- Quiet Package for shaker.
- Diaphragm seal.
- Cassette Taped Random Programming for production screening.

781C



TYPICAL MISSION TEST CYCLE PROFILE



A-Humidity Initiated
B-Humidity Terminated

THERMOTRON A.G.R.E.E. CHAMBERS

Designed for MIL-STD-781C

ASSURED COMPATIBILITY. . . Thermotron AGREE chambers are designed to be compatible with our Dynamic Shaker and System 311. Compliance with MIL—STD—781C test requirements are assured by the single source responsibility of Thermotron.

781C MOISTURE PACKAGE . . . A controlled atomizing spray is introduced into the air circulation pattern under command of the System 311. The moisture system is designed specifically to comply with 781C and is limited to those requirements. Additional elements of the moisture system include demineralizer, adjustable controller and a two pen, 12" circular chart recorder.

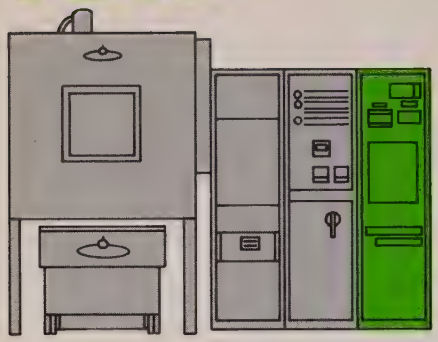
RELIABILITY. . . Thermotron has supplied more than 95% of all AGREE Chambers in the past fifteen years. If you need a complete new 781C system or any of the sub-systems shown in this brochure, Thermotron can meet your mission profile test requirements.

AGREE CHAMBER MODELS

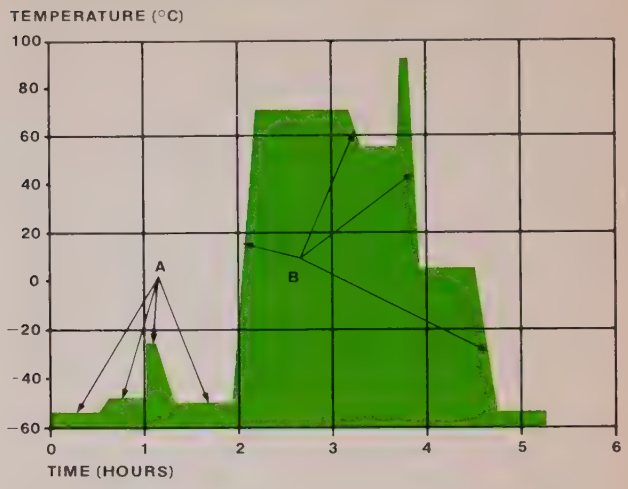
Model	I.D. Size W.	D.	H.	
F-32-CHV	40"	x40"	x36"	All DS Shaker Models
F-42-CHV	54"	x38"	x36"	
F-62-CHV	54"	x54"	x36"	
F-82-CHV	54"	x54"	x48"	
F-110-CHV *	72"	x54"	x48"	
F-117-CHV *	78"	x54"	x48"	
F-144-CHV *	72"	x72"	x48"	

*Two model DS 4000 or DS 4001 shakers can be applied to these AGREE chambers

781C

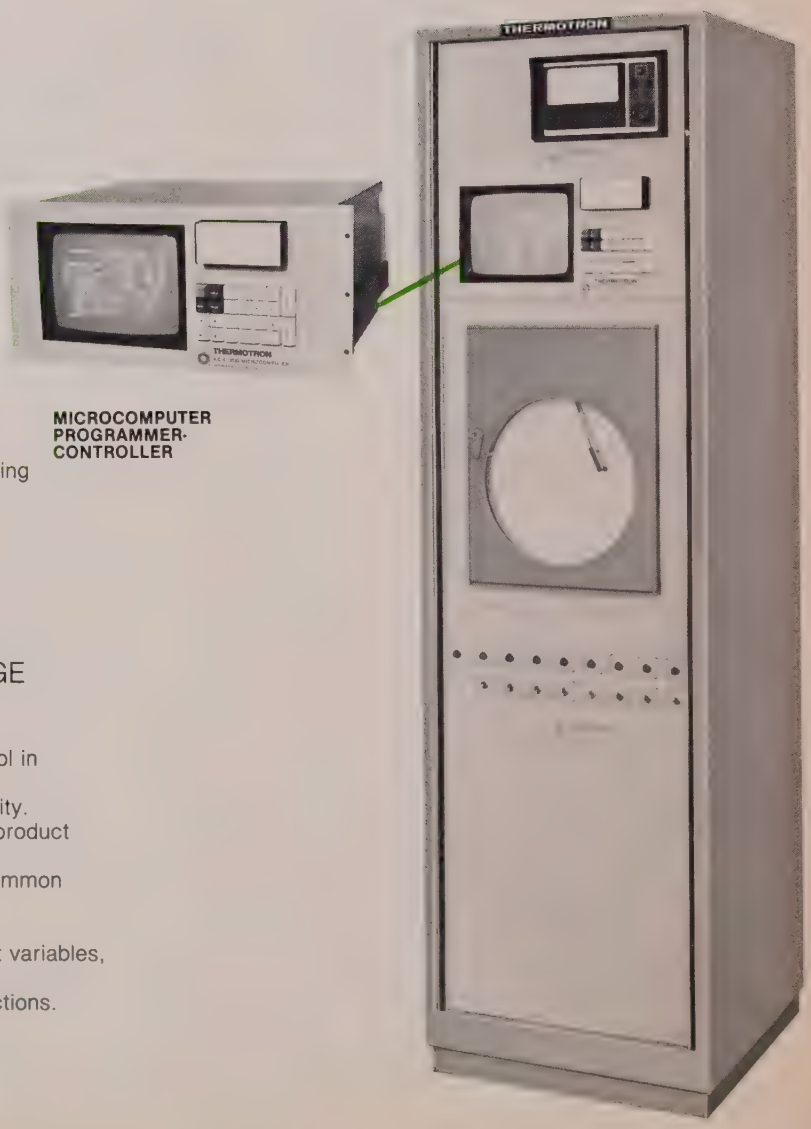


TYPICAL MISSION TEST CYCLE PROFILE



THERMOTRON SYSTEM 311

Takes command of mission profile programming with microcomputer precision.



MICROCOMPUTER PROGRAMMER-CONTROLLER

781C DEMANDS SYSTEM 311

Here's why—

The new requirements make traditional programming methods obsolete because

Typical mission profile requires:

- Multiple temperature levels. (A)
- Variable transition rates. (B)
- Humidity Control
- Precise sequencing of all test events.

SYSTEM 311 MEETS THE CHALLENGE

Here's how—

- 50 Test Profile intervals.
- Individual temperature and transition rate control in each interval.
- Dual channels program temperature and humidity.
- 8 auxiliary event channels sequence vibration, product power and other events.
- All programming operations synchronized by common time base.
- Human engineered for operating simplicity.
- Continuous alphanumeric CRT display of all test variables, test perameters and current interval.
- Resident system-prompted programming instructions.

THERMOTRON
Kollen Park Drive
Holland, Michigan 49423 U.S.A.
Phone (616) 392-1492 T.W.X. 810-292-6164

Form TI9-032 Printed in U.S.A.

ELECTRODYNAMIC VIBRATION TESTING SYSTEMS

PRODUCTION SCREENING
RELIABILITY DEMONSTRATION
LONG TERM VIBRATION LIFE
ENGINEERING EVALUATION
MISSION PROFILE TESTING
TRANSPORTATION SIMULATION

SINE OR RANDOM EXCITATION UP TO: 5000 POUND FORCE
1800 POUND PAYLOAD, 2000 HERTZ FREQUENCY

DYNAMIC SYSTEMS DIVISION

THERMOTRON

DYNAMIC SYSTEMS DIVISION

Electrodynamic Vibration Testing Systems

THERMOTRON'S D.S. SERIES

Vibration Testing Systems: The Thermotron Vibration Testing Systems are designed as a rugged and reliable simulation tool for production or long-term reliability tests.

These systems have the versatility and flexibility to provide laboratory simulations for most "field monitored" vibration or temperature/vibration environments.

The DS Series Vibration Testing Systems incorporates many unique features which provide the test and reliability laboratories the capability for a wide range of test applications.

APPLICATIONS

- Production Screening
- Reliability Demonstration
- Long Term Vibration Life
- Mission Profile
- Engineering Evaluation
- Transportation Vibration

FEATURES

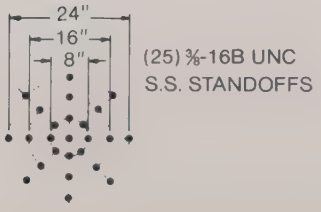
- Rugged, uncomplicated system design
- Capable of wide range of test applications
- Sinewave, random or complex excitation
- Reliable simulation tool
- Large table surface—24"
- Lower purchase, maintenance, and operating costs
- Vertical and horizontal systems
- Completely air cooled
- Combined temperature/vibration operation
- Delivery 12-16 weeks

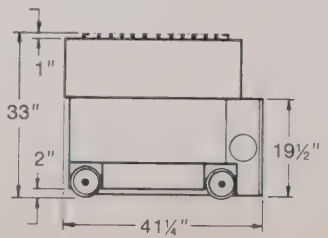
SPECIFICATIONS

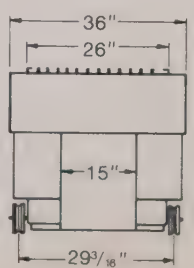
Frequency Range: 5 to 2000 Hz. Sinewave*, 20 to 2000 Hz. Random
Force Ratings: Sinewave—1200 to 4000 pound force peak. Random—1500 to 4000 pound force RMS**.
Displacement: 0.5" peak to peak (std.) 1.0 peak to peak (opt.) (Available with overtravel limit switch)
Armature Axial Resonance: Above 2 KHz. (bare table)
Rugged Armature Design: Single cast structure with 24 inch diameter specimen mounting surface minimizes fixturing expense.
Moving Element Weight: 130 pounds.
Suspension System: (8) eight Beryllium copper laminated leaf flexures combined with two linear guide bearings provide maximum control of off center loads and lateral movement of specimen.
Suspension Stiffness: 5000 pounds per inch.
Magnetic Field: Double-ended magnetic structure for maximum efficiency.
Stray Field: Less than 5 Gauss at 3 inches above mounting surface.
Cooling: All Systems are "totally" air cooled for maximum reliability. Shaker is cooled by remote cooling blower.
Power: 460V, 230V, or 208 VAC, 3 Phase, 60 Hz.
Weight: Shaker—approximately 6000 pounds. Control Console—approximately 1000 pounds.
Dimensions: See Below.
*Response to 2 Hz. available.
**Force rating to 5000 pounds RMS with specific loads.

SYSTEM ACCESSORIES

- Pneumatic Shaker Vibration Isolation System
- Shaker Trunnion Mounting Assembly
- Slip Tables, Oil Film and Bearing Type
- Air Isolated Seismic Base Assemblies
- Powertow Transport Assembly
- Diaphragm Temperature Chamber Seal
- Quiet Package for Cooling Blower
- Special Shaker Table Mounting Inserts







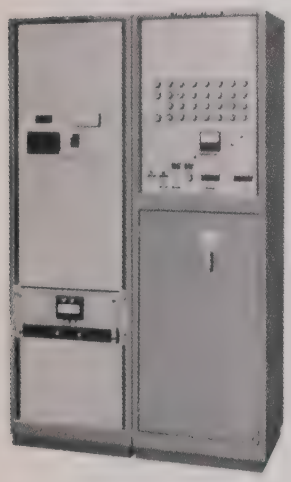
Electrodynamic Vibration
Testing Systems

DS Series of Vibration
Testing Systems

New Force Ratings
Effective August 1979

THERMOTRON INDUSTRIES
Dynamic Systems Division
438 Cleveland Avenue
Holland, Michigan 49423 U.S.A.
Phone (616) 392-1491 T.W.X. 810-292-6164

Now 1900 lbs Force RMS

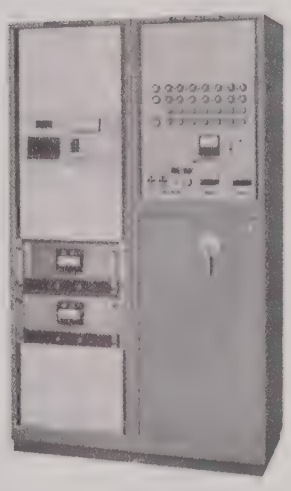


DS-1500 Control Console
(shown with optional SE-28 Equalizer and Microcommand Programmer) The DS-1500 is the most economical approach, providing **1900 pound force RMS random*** and **1700 pounds force sinewave** for small and medium test specimen. System may be uprated in the field to a DS-4000.

***For flat power spectral density over the frequency range 20-2000 Hz with loads of 160 pounds or greater.**

THREE STANDARD SYSTEMS AVAILABLE

The DS Series of Vibration Testing Systems includes three standard models which exhibit performance capabilities from 1900 lbf RMS to 6000 lbf RMS. These three basic systems have the flexibility and versatility to be configured for sinewave, random or field monitored vibration tests. All systems utilize the rugged large table electrodynamic shaker for maximum reliability.



DS2500 Control Console
(shown with optional SE-28 Equalizer and Microcommand Programmer) The DS-2500 will handle most vibration applications with the 2000 pounds force sinewave and 2500 pounds force RMS random ratings.

EACH SYSTEM INCLUDES:

- o Large Table Electrodynamic Shaker with V-grooved wheels and integral monitor accelerometer.
- o Remote cooling blower assembly with flexible duct.
- o Thermal Shield, -57° to +93° C.
- o Standard interconnecting cable assemblies.
- o Two bay Control Console including:
  - o DC Field Power supply
  - o Direct Coupled Solid State Power Amplifier
  - o Overall Vibration Level Monitor with high safety cutoff
  - o Central Control Panel for Local or Remote system operation.

Now 6000 lbs Force RMS

DS-4000 Control Console
(shown with optional SE-28 Equalizer and Realtime Analyzer) The DS-4000 is designed for testing large or multiple specimen to increased acceleration levels. With heavy payloads the system will provide force ratings in excess of the standard **6000 pounds force RMS random* or 4500 pounds force peak sine wave.**

DYNAMIC SYSTEMS DIVISION

THREE STANDARD SYSTEMS AVAILABLE

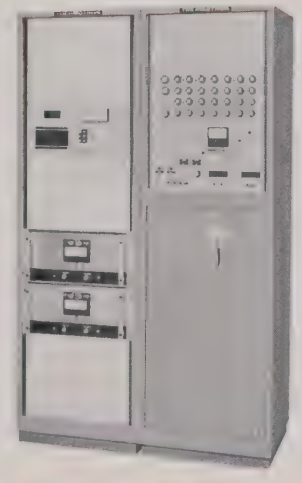
The DS Series of Vibration Testing Systems includes three standard models which exhibit performance capabilities from 1500 lbf RMS to 4000 lbf RMS. These three basic systems have the flexibility and versatility to be configured for sinewave, random or field monitored vibration tests. All systems utilize the rugged large table electrodynamic shaker for maximum reliability.

EACH SYSTEM INCLUDES:

- Large Table Electrodynamic Shaker with V-grooved wheels and integral monitor accelerometer.
- Remote cooling blower assembly with flexible duct.
- Thermal shield, -57° to +93° C.
- Standard interconnecting cable assemblies.
- Two bay Control Console including:
  - DC Field Power supply.
  - Direct Coupled Solid State Power Amplifier
  - Overall Vibration Level Monitor with high safety cutoff.
  - Central Control Panel for Local or Remote system operation.

DS 1500 CONTROL CONSOLE

(shown with optional SE-28 Equalizer and Microcommand Programmer) The DS-1500 is the most economical approach, providing 1200 pound force sinewave and 1500 pounds force RMS random for small and medium test specimen. System may be uprated in the field to a DS-4000.

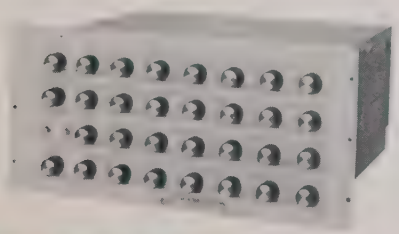


DS 2500 CONTROL CONSOLE

(shown with optional SE-28 Equalizer and Microcommand Programmer) The DS-2500 will handle most vibration applications with the 2000 pounds force sinewave and 2500 pounds force RMS random ratings.

DS 4000 CONTROL CONSOLE

(shown with optional SE-28 Equalizer and Realtime Analyzer) The DS-4000 is designed for testing large or multiple specimen to increased acceleration levels. With heavy payloads the system will provide force ratings in excess of the standard 4000 pounds force sinewave or random.



INSTRUMENTATION

The DS-series Vibration Testing Systems are compatible with a wide range of control and monitoring instrumentation. Specific instrumentation is assembled and integrated into the system to meet your particular testing requirements. This instrumentation includes:

- The Model SE-28 Spectrum Equalizer
- Model SD330A Realtime Analyzer
- Sinewave Oscillator/Servo Systems
- Closed Loop Digital Vibration Control Systems
- Data Acquisition Monitoring Accelerometers
- Microprocessor Based Master Test Programmers.

HORIZONTAL OPERATION

All of the DS-series shakers have the capability for accepting a trunnion mounting facility for use with slip tables and pneumatic isolated seismic base assemblies. Trunnion assembly may be easily removed for vertical vibration and AGREE testing chambers without extensive modifications

Thermotron Puts It All Together . . .

Total systems for mission profile test realism
VIBRATION—TEMPERATURE—MOISTURE/HUMIDITY

In adding electro-dynamic vibration to our many other capabilities in environmental testing, Thermotron combines 15 years experience and total systems expertise as a single source.

The more precise requirements demanded by updated MIL SPECS. plus the ever increasing pressures of consumerism and liability exposure call for much more than just a "shaker".

An integrated wideband system gives you the capabilities needed for today's requirements and the versatility for those which the future will bring.

Jim Koscelnik
Division Sales Manager

THERMOTRON®

THERMOTRON INDUSTRIES
DYNAMIC SYSTEMS DIVISION
KOLLEN PARK DRIVE, HOLLAND, MI 49423;
PHONE (616) 392-1492 / 396-1727

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Merrick, New York 11566
Phone: (516) 868-1800

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THERMOTRON

Worldwide Service for Environmental Chambers and Instruments

Keep them working; fix them when they fail.

Murphy's law states "if something can go wrong, it will." Thermotron's Field Service law says "that's not necessarily so, but if it does, we'll fix it and quick too."

And that's where Thermotron's Field Service program comes in. It exists simply because no matter how well we build our environmental simulation chambers and instruments, things sometimes can go wrong.

When it does it costs you, our customer, time, money, and inconvenience. It's our goal to prevent breakdowns before they happen. And when that isn't possible, to make sure we put your equipment back in perfect working order quickly, efficiently and economically.

To do it, we've assembled a worldwide service network. It includes regional, branch and factory service technicians and representatives skilled in all facets of servicing sophisticated environmental test simulators and chambers.

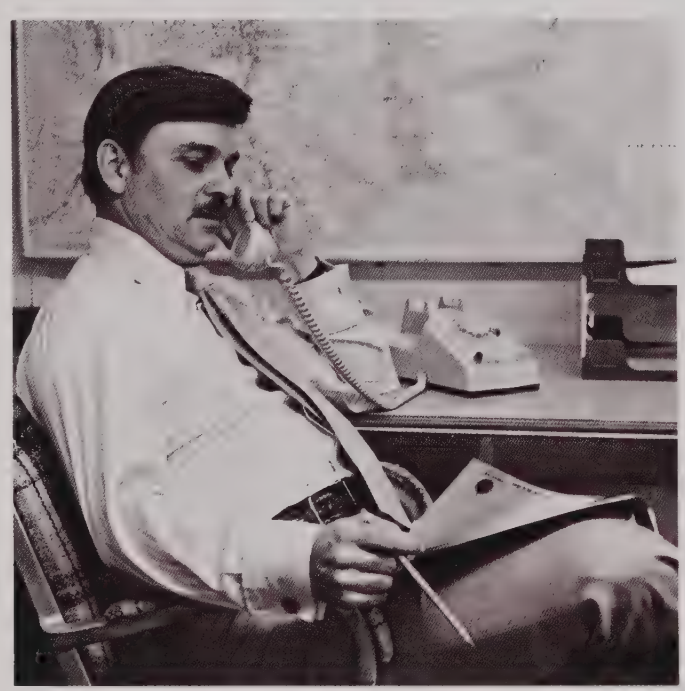
The map inside shows how far we've come and we also provide a brief explanation of the ways in which we can help you keep your Thermotron equipment operating at peak efficiency.

Please feel free to contact me if you have any comments or questions about Thermotron Field Service—my hot line is 616-392-1492.

Sincerely,

Robert G. Wiley

THERMOTRON CORPORATION
Robert G. Wiley
Vice President, Product Support



A Total Program

From the moment you install your Thermotron environmental simulation chamber you'll be assured of the most professional field service in the industry. We welcome the opportunity to be of assistance.

Field Service

There are 54 Thermotron service technicians and representatives located throughout the United States. Each is highly skilled, and intimately familiar with both the theoretical and practical aspects of environmental simulation chambers.

You may have come in contact with one of them even though you've never experienced a problem with a Thermotron chamber. Many of our more complex chambers require factory-supervised installation and start-up. A technician performs it in your facility, and he stays on the job until the equipment is operational and your personnel are skilled in its operation and general maintenance.

Field technicians also perform warranty service, of course. (Thermotron products carry a 90-day labor warranty and one-year parts warranty).

But perhaps their most important function is the contract service program. Call it planned maintenance, or preventive maintenance, or whatever you want, the results are the same—more efficient equipment operation and virtual elimination of costly, inconvenient downtime. Several contract maintenance programs are available to fit your specific requirements.

Parts

No matter how skilled a technician may be, he's just another guy if he doesn't have the right replacement parts. We don't intend to let that happen.

Our first line of defense involves local service trucks. They're all stocked with a complete inventory of the most frequently needed parts. And they're ready to roll when you need help.

Regional supply depots carry a more extensive parts inventory. Seldom will the depot nearest you be unable to fill a replacement part order.

If it ever *does* happen, the main factory warehouse at Holland, Michigan will air-ship any part within 24 hours.

Parts aren't a problem. Not when you have Thermotron chambers.

Training

In addition to providing comprehensive training to our technicians, we'll school your laboratory technicians and supervisory personnel in the techniques of chamber operation and preventive maintenance. The sessions are provided to you free of charge. Your only expense will be for travel and lodging for your personnel.

When necessary, we will conduct training sessions in your plant. On-site training programs are generally feasible only when a large number of your employees can participate. A nominal fee is charged to cover the expenses of our Field Service Instructors.

To round out the program, we provide comprehensive technical manuals and handbooks on the operation and maintenance of Thermotron equipment.

Product Support

THERMOTRON INDUSTRIES
Kollen Park Drive
Holland, Michigan 49423
Phone (616) 392-1491
T.W.X. 810-292-6164

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Representative:

Seattle, WA

REGION 2—CENTRAL STATES

Regional Office:

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Suite 2319
Dallas, TX 75243
Phone: (214) 231-3663

Representatives:

Albuquerque, NM
Denver, CO
Ozark, AR

REGION 3—MIDWEST

Regional Office:

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Holland, MI 49423
Phone: (616) 392-1492

Representatives:

Chicago, IL
Detroit, MI
Indianapolis, IN
Minneapolis, MN

REGION 4—EAST/NORTHEAST

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Phone: (516) 868-1800
(315) 475-5820

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Phone: (617) 890-0741

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Newark, NJ
Washington, D.C.

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5037 Rio Vista
Tampa, FL 33614
Phone: (813) 884-4007

Representatives:

Atlanta, GA
Miami, FL
Huntsville, AL

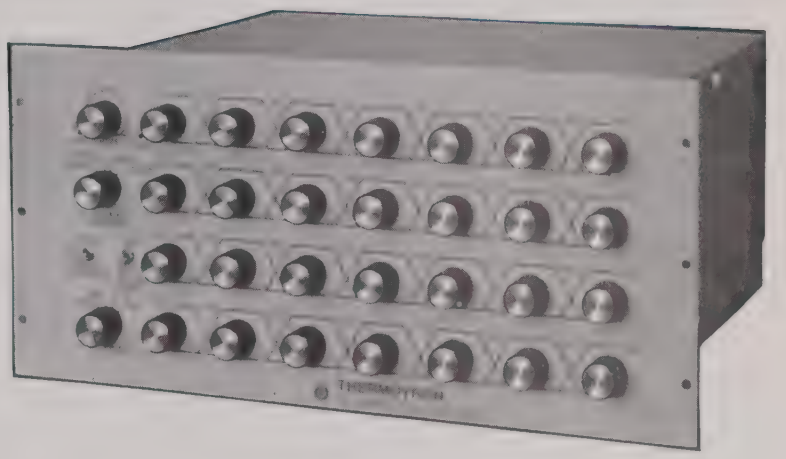
THERMOTRON

DYNAMIC SYSTEMS DIVISION

MODEL SE-28

SPECTRUM EQUALIZER

- Economical Random Spectrum Shaping for MIL-STD-781C
- 28 individual Equalizer Channels
- Six and eight pole Butterworth active filters
- 60 dB Signal Equalization Dynamic Range
- Integral Single or Dual Noise Generator
- Remote Equalized output signal level programming
- Mixed Sine/Random capability
- Expansion capability for additional channels

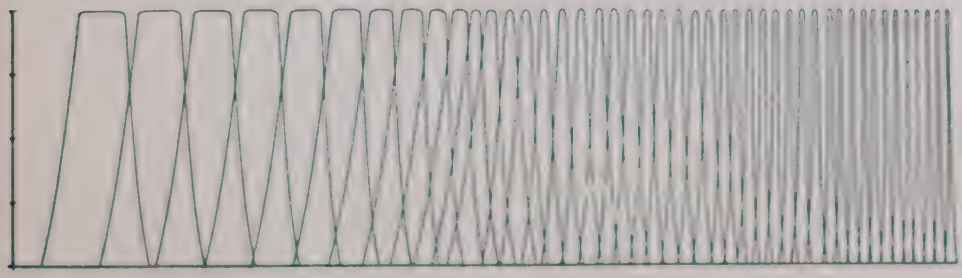


GENERAL DESCRIPTION

The Model SE-28 Spectrum Equalizer combines the latest in integrated circuitry with the time-tested principles of manual signal conditioning to provide the most economical approach to random spectra shaping for MIL-STD-781C.

The SE-28 is a manual equalizer incorporating twenty-eight independent active filters with individual front panel GAIN/ATTENUATOR controls. The active filters are extremely stable three and four pole pair butterworth design for maximum spectrum shaping resolution. All of the bandpass filters are driven in parallel from an internal noise generator. The outputs of the filters are summed and buffered to be compatible with all types of Electrodynamic Vibration Testing Systems. Through the use of the auxiliary input, an external sinewave signal may be mixed with the equalized random output.

An outstanding feature of the SE-28 is the capability for being programmed for shaker on-time at any predetermined sequence by an external source such as a Microprocessor or other time related device. When commanded to turn on, the equalized output is smoothly increased to the required test level.



FILTER RESPONSE

Form 3004 · 11 · 30 78 Printed in U.S.A.

MODEL SE-28
SPECTRUM EQUALIZER

SPECIFICATIONS

Frequency Range: 10 Hz to 2000 Hz (standard) Optional frequency range available.

Filter Compliment: 28 integrate active filters, 10 4-pole pair Butterworth, 18 3-pole pair Butterworth.

Note: See Table I for actual filter placement and bandwidth.

Filter Response (Typically):

3 POLE
−35dB points: $\triangle F < 4$ times filter bandwidth
−50dB points: $\triangle F < 7$ times filter bandwidth

4 POLE
−35dB points: $\triangle F < 3$ times filter bandwidth
−50dB points: $\triangle F < 4.5$ times filter bandwidth

Ripple Factor: Less than ±1.5dB.

Noise Source: Internal wide-band 10 Hz to 10 KHz solid state noise generation with spectral uniformity of ±1dB. Band limited to 3 KHz. Optional second noise generator driving alternate channels to eliminate phase coherence between adjacent filters is available.

TABLE I
Filter Compliment

Channel No.	−3dB Frequencies		Bandwidth
	LOWER	UPPER	
1	10 Hz	20 Hz	10 Hz
2	20	30	10
3	30	50	20
4	50	70	20
5	70	100	30
6	100	150	50
7	150	200	50
8	200	250	50
9	250	300	50
10	300	350	50
11	350	400	50
12	400	450	50
13	450	500	50
14	500	600	100
15	600	700	100
16	700	800	100
17	800	900	100
18	900	1000	100
19	1000	1100	100
20	1100	1200	100
21	1200	1300	100
22	1300	1400	100
23	1400	1500	100
24	1500	1600	100
25	1600	1700	100
26	1700	1800	100
27	1800	1900	100
28	1900	2000	100

Amplitude Probability Distribution: Gaussian.

Clipping Level: Selectable for 2, 3, 4 sigma and infinity.

Signal Equalization Dynamic Range: 60dB (±30dB) provided by 28 single turn filter gain controls.

Bass Boost: To compensate for shaker roll-off characteristics at low frequencies, a network for increasing the L.F. gain is switch selectable to provide a rising +6dB/octave boost below 100 Hz.

Inputs: (10VP-P max)

External — switch selectable for signal source to drive filter compliment.

Auxiliary — allows external signal to be mixed with equalized random signal. (sine/random)

Outputs: 20 V P-P Max. into 50 OHMS

Noise Generator output — Band limited and buffered for 1V RMS into 1K OHM.

Remote Programming Feature: In the remote mode the SE-28 equalized output is automatically activated and deactivated by an external D.C. logic signal. (TTL compatible)

To avoid transient shock to specimen under test, the equalized Random output is increased by an electronic gain control circuit, which provides a smooth transition to full output level.

Indicators:

POWER: L.E.D. Front Panel.

OVERDRIVE: Indicates overdrive condition of output amplifier.

POWER: 120 VAC, 50/60 Hz Approx. 50W.

SIZE: Front Panel — 19"W x 8.75"H x 14"D.

THERMOTRON®
THERMOTRON INDUSTRIES
DYNAMIC SYSTEMS DIVISION
KOLLEN PARK DRIVE, HOLLAND, MI 49423
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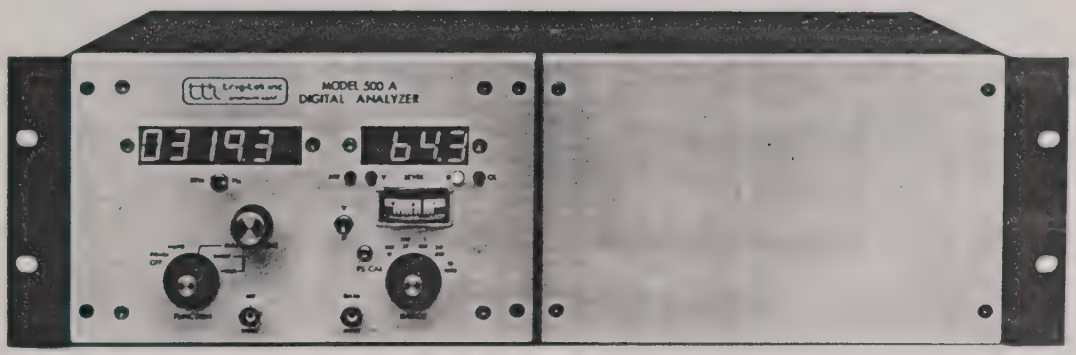
tti

MODEL 500
DIGITAL ANALYZERS



- **Narrow Band**
- **Tracking Filter**
- **Swept Analyzer**
- **Manual Tuned Analyzer**
- **5-5,000 Hz (300-300,000 RPM) range***
- **Amplitude in Volts and G's**
- **Sin - Cos Output (Phase) Polar Plots (for balancing of rotating equipment)**

The is a multi-function analyzer that provides several methods of analyzing a signal. It is a tracking filter, a swept analyzer, a manually tuned analyzer, and provides analysis of an input signal by displaying digitally the amplitude and frequency of the individual components of that signal; plus it provides phase information between the input signal and a reference signal. Analog outputs as well as the digital displays of frequency and amplitude are provided. These two analog voltages can be used to drive an X-Y recorder to make frequency versus amplitude plots.

One of its major applications is in the vibration analysis of rotating equipment and provides therefore indications of speed in RPM as well as frequency in Hz; and amplitude readings in G's as well as Volts. A four pole filter permits separating closely adjoining frequency components.

Frequency readings are provided with 0.1 Hz resolution updating every 2/3 second; or RPM readings are provided with 10 RPM resolution updating every 3/4 seconds. The frequency is displayed by a six digit counter. Amplitude readings are provided on five Voltage and five G scales. The scales are 100 mV, 300 mV, 1, 3, and 10 Volts; or 10g, 30g, 100g, 300g, and 1000g full scale. The amplitude is displayed on a 3-1/2 digit digital voltmeter. An overload indicator (red light) illuminates if the scale being used is incorrect. In addition to the digital meters, a small analog amplitude meter is provided (connected in parallel with the digital amplitude meter) allowing the operator to watch as a frequency component is nearing the center of the filter, or allows an operator to manually tune to a "peak" if he is manually tuning the analyzer.

In the Auto (Automatic) mode of operation the analyzer will "lock-on" and automatically track a changing reference signal insuring that the component being tracked is always in the center of the filter. Because the reference signal wave-shape and amplitude may vary with application, the instrument is designed to accommodate a wide variety of signals. These signals for example can be a sine wave from a sweep oscillator, a square wave from a frequency divider, a pulse from a "once-per-rev" pick-up on a turbine engine, etc. The reference input circuitry is designed to accept any of these type signal and program the analyzer to measure the amplitude of that frequency component of the complex signal at the data input. The AUTO mode can be used to make phase measurements between the DATA INPUT signal, and the REF. INPUT signal. The SIN and COS outputs on the rear panel provide the rectangular components of the data input signal such that when displayed on an X-Y recorder, produce a polar plot of the phase and amplitude vector of the data input signal, using the reference input as a phase reference. "Trim-Balancing" of rotating equipment is easily accomplished.

The printed circuit cards within the chassis are interconnected one to the other by plug-in connectors with flexible cables making the inside package modular. The large digital indicators (0.6") are easily seen at a distance allowing an operator to work at a station somewhat removed from the analyzer. The all solid state and digital CMOS circuitry provides for low power consumption and long trouble free and reliable service.

Specifications subject to change without notice.

* Other Frequency Ranges available

tri-tek inc 428 S. Brookhurst St. (Bldg. E) Anaheim, Calif. 92804 (714) 956-3593

DATA

Frequency	5 Hz to 5 kHz*
Level	0 to 10 Volts rms, Input guarded up to 150 volts rms
Impedance	300 K Ohms
Common Mode Rejection	Greater than 50 dB at 60 Hz

REFERENCE SIGNAL

Frequency	5 Hz to 5 kHz*
Level	10 mV rms to 20 V rms Input guarded up to 150 V rms
Impedance	300 k Ohms
Waveform	Sine, Square, Pulse (20 usec. or wider) or Triangle
Common Mode Rejection	Greater than 50 dB at 60 Hz

DC OF FREQUENCY

Level	5 Volts at 5,000 Hz*
Accuracy	0.5% of indicated plus 0.1% of full scale
Impedance	Less than 50 ohms (5 ma)
Response Time	100 milliseconds

DC OF AMPLITUDE

Level	10 Volts full scale
Accuracy	2% of indicated plus 0.2% of full scale
Impedance	Less than 50 Ohms (5 ma)
Bandwidth	Ten Hz bandwidth, four pole Bessel filter**

COSINE AND SINE

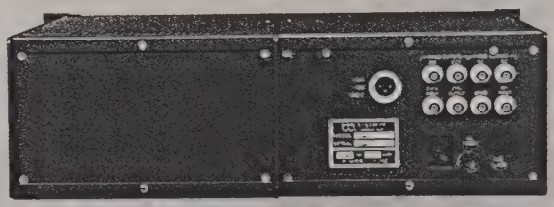
Quadrature	90° ±0.5° between Sine and Cosine
Level	±10 Volts full scale
Impedance	Less than 50 Ohms (5 ma)
Offset (zero input, 100Hz)	0 ±10 mV
Differential Phase Shift between Reference and Data Inputs	±2° from 10 Hz to 3000 Hz

(Reference Channel must be Square or Pulse waveform.
Phase is established from positive going edge.)

SIZE: 19" wide x 5.25" high x 12" deep (48.26 cm x 13.33 cm x 30.48 cm)
POWER: 120 Volts, 50-400 Hz, 10 watts
WEIGHT: 15 lbs. (33 kgms)

TUNING FUNCTION (Switch)

Off	Turns power off
Auto	Analyzer functions as a tracking filter and will automatically acquire and track the signal at the Reference Input
Manual	Analyzer must be manually tuned by means of the Tuning Control



Sweep	Analyzer will sweep upward at approx 10 Hz/sec. It will start at the frequency set in by the manual tuning control. (Other sweep speeds available on request)
Sweep Hold	Will Stop the sweep and hold at the frequency when selected

RANGE (Switch)

Calibrate	Connects an internal calibrator to the Data Input
100mV, 300mV, 1V, 3V, 10V	Provides for full scale digital meter readings as indicated in Volts
10g, 30g, 100g, 300g, 1000g	Provides for full scale digital meter readings as indicated in g's. (10mV/g sensitivity)

V-g (Switch)

V	Scales the DVM for Volts (units)
g	Scales the DVM for g's (units)

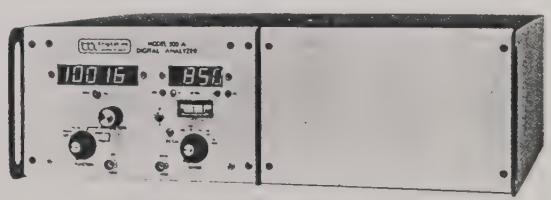
RPM-HZ (Switch)

RPM	Sets the counter to indicate from 0 to 300,000 RPM
Hz	Sets the counter to indicate in Hz with 0.1 Hz resolution from 0 to 5,000.0 Hz
Cal	Selected by Cal position of Range switch. Fifteen turn pot (screwdriver) for setting the Analyzer gain 100.0 mV or 10.00 g full scale
Tuning	Ten turn pot. allowing operator to manually tune the analyzer from zero to 5,000 Hz.*

O/L (Overload)	Red light illuminates if input to filter or output of filter is too high.
LEVEL (Analog meter)	Small meter providing course amplitude of signal. Allows operator to observe signals moving into and out of filter.
LEVEL (Digital meter)	Digital panel meter indicating amplitude level of filter signal in either Volts or g's.
RPM-Hz	Digital counter providing six digit indication of RPM, or five digit indication of Hz.
mV	Illuminates when 100 or 300 mV range is selected.
v	Illuminates when the 1, 3, or 10 Volt range is selected.
g	Illuminates when the 10, 30, 100, 300 or 1000 g range is selected.

PACKAGING

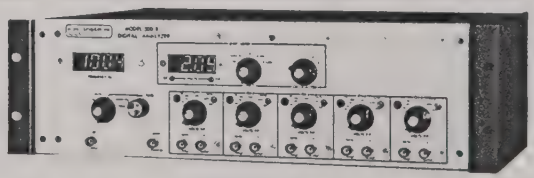
The **Model 500A** or **Model 500D** is available in a 19" wide rack mountable chasis, or a 19" wide bench mount chassis as shown here. Note two units can be mounted side by side in a single 19" wide chassis. For Bench work, the unit can be supplied in a 1/2 chassis 8-1/2" wide with handles.



Model 500A Bench Mount

MODEL 500D

The Model 500D is exactly the same as the Model 500A with the addition of a position on the Function switch labeled "OVERALL." This position provides monitoring of the wide band signal without narrow band filtering.



MODEL 500B

This is a five channel system nearly identical to the 500A but covering the frequency range of 1 Hz to 500 Hz (5 Hz to 5,000 Hz optional). It provides front panel meter indication of Freq. in Hz and amplitude in Peak Volts. Also provides front panel indication of Sin, COS and amplitude outputs of each channel. BCD of frequency and amplitude available. See individual specification sheet for complete detail.

Specifications subject to change without notice.

* Other Frequency Ranges available
** Other Filter Bandwidths Available on request

The Model 500AS Digital Analyzer is a modified version of the standard Model 500A Digital Analyzer. It is designed to measure random wave inputs, as well as, periodic waveform inputs. One of the major measurements of random waves is the analysis of vibration data, where the required data is plotted in the terms of g^2 mean square/unit bandwidth (g^2/Hz). This requires the data be squared, and then divided by the bandwidth of the filter. The detection process within the analyzer is basically an averaging type detector as is found in most standard type voltmeters not measuring TRUE RMS. Averaging type volmeters are widely used throughout the industry, but are calibrated to read rms.. This calibration holds true, however, only if sine waves are applied to the input of the meters. If signals other than sine waves are measured, different type errors are made by the averaging process. The amount of error found in such an averaging type meter, calibrated for rms, and actually measuring random waves instead of sine waves, is about -11% (or about 11% low).

The Model 500AS provides a front panel switch labeled 1/BW which can be placed in or out of the circuit. When this switch is placed in the circuit, it not only provides the function of dividing by bandwidth, but also compensates for the -11% error caused by the averaging type detectors discussed above. Also, since twice the log is tantamount to squaring, the squaring function is performed by measuring the log of the output and plotting twice the log.

NOTE: The Model 500AS-1 contains an internal Logarithmic Converter for both the X and Y (frequency and amplitude) inputs, and a front panel switch with a 0dB and -20dB position

THERMOTRON

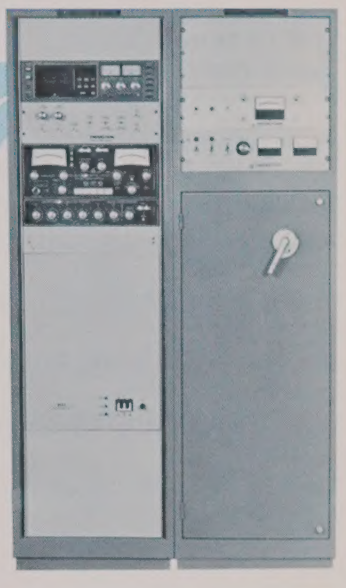
TAPED RANDOM PROGRAMMING SYSTEM TRP-I & TRP-II

Dynamic Systems Division
438 Cleveland Avenue
Holland, Michigan 49423 U.S.A.
Phone (616) 392-1492 T.W.X. 810-292-6164

- Economical random vibration for repetitive random screening applications
- Reduces cost for multiple test facilities
- Converts existing sinusoidal systems to random vibration
- Supports NAVMAT P-9492 Manufacturing Screening Program
- Utilizes simple cassette tapes

Model C-3 Tape Deck

Model ABM 8208



TRP-I

General Description

The TRP-I and TRP-II Taped Random Programming Systems are designed to provide low cost, synthesized random vibration for random screening applications.

To provide the necessary shaker excitation the TRP-I and TRP-II Systems utilize a cassette tape deck and a preprogrammed cassette tape, in lieu of the more expensive random programming devices.

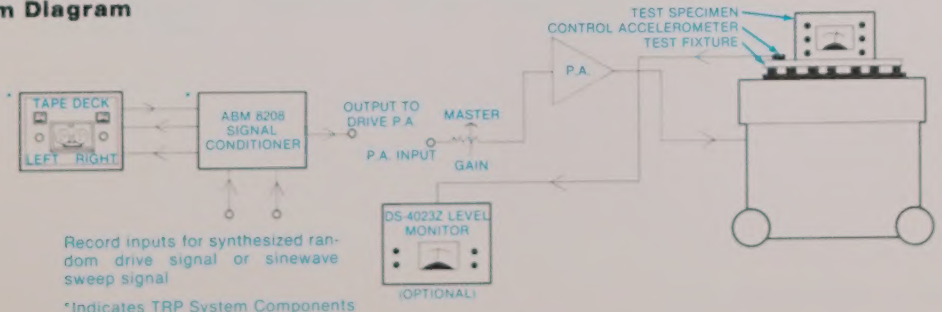
The TRP-I System is incorporated into the vibration console of a new DS-Series Electrodynamic Vibration Testing System.

The TRP-II System is a retrofit designed to utilize existing electrodynamic sinusoidal vibration systems. The TRP-II System can be incorporated into the present system vibration console if space is available or supplied with an optional console.

Both the TRP-I and TRP-II consist of a two channel cassette tape deck, a Model ABM-8208 Signal Conditioner and all interconnecting wiring between the two. The tape deck incorporated in the TRP System utilizes either standard cassette tape or metal particle tape for an increased dynamic range and signal/noise ratio.

The Model ABM 8208 Signal Conditioner is designed to interface the cassette tape deck with the Vibration System. The Signal Conditioner can either attenuate a signal (within the specified range) to the proper level for recording by the tape deck or provide gain for a signal from the tape deck of sufficient level to drive the power amplifier of a vibration system.

Typical System Diagram



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Specifications TRP-I &TRP-II Taped Random Programming System

Frequency Response (Overall): 20 to 3K Hz. 25 – 3K Hz. ± 3d B

Dynamic Range: 40 dB (Minimum)

Input (Record Mode): 70mv - 20 volts RMS

Output (Playback Mode): 0 - 4.0 volts RMS

Signal to Noise Ratio: 50 dB (Minimum)

Wow and Flutter: (NAB Weighted) .05%

Tape Speed: 1-7/8 inches per second

Counter: 0 to 999

Metering: VU Meter for each channel—Functions in both record and playback modes.

Actual Random Test Time:
30 minute tape—
17.5 minutes test time;
45 minute tape—
32.5 minutes test time.

Tape Performance:
Standard Tape—Cobalt-treated ferric-oxide cassette
Special Tape—Metal particle cassette for increased dynamic range and improved signal to noise ratio)

Input/Output Connectors: BNC

Power Requirements: 120 VAC 50/60 Hz., 40W

Dimensions: 19"W x 11"H x 13½"D

Weight: 32 pounds (Does not include optional console for TRP-II)

Typical Data Recorded on Tape

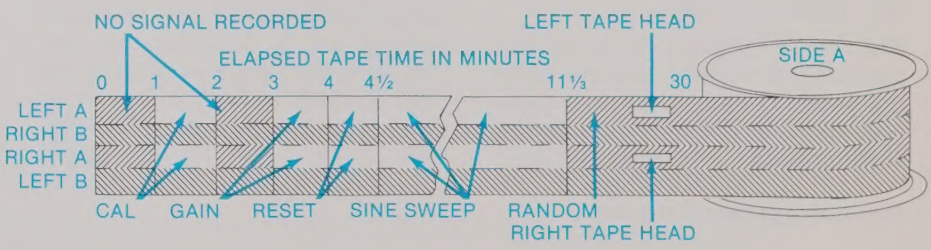
CAL Calibration Signal; Typically Sine Signal of 1KHz

GAIN Sinewave Gain Reference Signal

RESET Low Level Sine Signal (while resetting to 2KHz)

SINE SWEEP 1.0g Sine Sweep 2KHz to 20 Hz

RANDOM Synthesized Random Drive Voltage



Specifications subject to change without notice.

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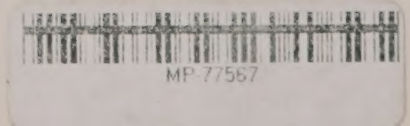

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